are the proximal convoluted tubules, which, with the glomeruli, are derived from and therefore represent the original parts of the kidney of the earliest vertebrates and of the protovertebrates. The proximal convoluted tubules are also concerned in reducing the H-ion concentration of the blood, for they secrete acid, not acid salts, into the urine, a function which is also very ancient, a function performed in invertebrates by all the cells of the body situated near the body surface, and still performed intermittently and with a high degree of specialization by the gastric glands of vertebrates. In some invertebrates other tissues have specialized in this matter also, as for example, in the salivary glands of the carnivorous mollusc *Dolium galea,* the concentration of the sulphuric acid of the "saliva" of which exceeds 4 per cent.

It may be that the function of preventing the ever-tending-to-increase of the H-ion concentration of the blood plasma is as ancient as the Palæo-oceanic function, a view which their common localization in the proximal tubules supports.

Enough has been said here to emphasize the view that behind the functions of the renal organ is a history which links up the human body with the far past with an age of the earth when its oceans contained only what would now be regarded as brackish water and the earliest type of vertebrate life was just beginning to appear as a marine form. From the facts advanced it will be gathered also that the blood plasma, so far as its inorganic salts are concerned, is but a reproduction of the remotely ancient ocean, and that it is an heirloom from the life in

> "that immortal sea
> Which brought us thither,"

not indeed in the Wordsworthian sense, but in the literal one, for the sea is the original home of all life on the globe and gave our blood, and, accordingly, the tissues of our bodies, a character that long ages have not effaced and will not efface.

TYPHOID VACCINE IN A CASE OF TYPHOID SPINE.

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As only 30 out of the 104 cases of typhoid spine reported up to this time have been accompanied by roentgenograms, we feel justified in reporting a case with positive roentgen findings, and so far as we have been able to discover, typhoid vaccine has not been used before in the treatment of this condition.

Few medical subjects have been so constantly and so thoroughly reviewed as typhoid spine, so that in reporting this case only a very brief summary of the development of our present knowledge on this subject will be given. Gibney,[1] in 1889, first called attention to the stiff and painful back which occasionally follows typhoid fever. However, his "Austrian Tyrol" case, with symptoms lasting two years, followed by permanent wry-neck, rather confused typhoid spine, with other types of spondylitis. Gibney reported this case to support his view that typhoid spine is a definite, infectious (inflammatory) process; this case is condemned by Lord[2] but approved by Halpenny.[3]

A few years later the waters were muddied when Osler[4] reported 4 cases of typhoid spine as simple neuroses. Inasmuch as postmortem pathology was not available in this condition, this conclusion could not be eliminated until some years later, when the roentgen rays began to demonstrate bony changes that are apparently responsible for the pain and the nervous symptoms. Lord, in 1902, reviewed the 26 cases reported up to that time, and concluded that the "pathology seems to be a perispondylitis or spondylitis, or both," and that although a few cases might be simple neuroses, "the coexistence of a deformity and nervous symptoms in one-half of the neurotic cases suggests that all the neurotic cases may be organic as well." At that time only Cutler's[5] case had been radiographed and no bony changes were found.

In 1905 Fluss[6] reviewed the subject, finding 46 cases. The next year T. McCrae[7] reported 2 cases with roentgenograms and was the first to give roentgenographic proof of the new-bone formation which usually occurs. Halpenny reviewed the subject very thoroughly down to December, 1908, summarizing 73 cases, and Elkin and Halpenny[8] have reviewed an additional 22 cases occurring up to the end of 1913, making a total of 95 cases.

In 1914 Conklin[9] and Job[10] each reported 1 case; in 1915 Galli,[11] Wilcox,[12] and Rugh[13] reported single cases and Carnett[14] reported 4 cases; we have found no cases reported during 1916.

Typhoid spine comes on within three months after typhoid fever either suddenly or gradually, with pain in the back, which is apt to be severe. The character of the preceding fever is without significance. Three-fourths of the sufferers are males, and a history of more or less trauma is usually to be obtained. The lumbar spine is the site of election and the pain may radiate to the front of the body and down the legs. Movement of the spine is exquisitely painful, so that the back is held rigid, and sleep is very much broken by relaxation at night. Spasm of the muscles is frequent and abdominal rigidity has been observed. Carnett reports rhythmic contraction of the abdominal muscles. Tenderness over the spine is common, with occasional hyperesthesia, ankle-clonus, increased knee-jerks and muscular atrophy. After much suffering the victims become very neurotic. Half the cases have fever of an irregular type and the leukocyte counts reported have varied from 6000 to 17,600. About half the cases develop deformity, varying from slight prominence of one or several vertebral spines to marked kyphosis or scoliosis, a small number of these deformities being permanent. The duration of symptoms ordinarily is from three to five months, and no recurrences have been reported. Under rest, either postural or mechanical, tonics and the cautery all patients have completely recovered, except that in a small number permanent deformity with some limitation of motion has persisted.

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[1] New York Med. Jour., 1889, i, 596–598; Tr. Am. Orthop. Surg., 1889, ii, 19.

[2] Boston Med. and Surg. Jour., 1902, cxlvi, 26, 689–691.

[3] Surg., Gynec. and Obst., 1909, viii, 649.

[4] John Hopkins Hospital Bull., xxv, 265; ibid., iv, 73 and v, 315.

[5] Boston Med. and Surg. Jour., 1902, cxlvi, 26, 687–689.

[6] Centralbl. f. Grenzgeb. der Med. u. Chir., 1905, viii, 645.

[7] AM. JOUR. MED. SC., 1906, cxxxii, 878–889.

[8] British Jour. Surg., 1914, i, 4, 602–609.

[9] Med. Record, 1914, lxxxv, 4.

[10] Bull. et mém. Soc. méd. de hôp. de Paris, 1914, xxx, 990.

[11] Münch. med. Wchnschr., April 13, 1915.

[12] Colorado Med., 1915, xii, 7.

[13] Am. Jour. Orthop. Surg., 1915, xii, 2.

[14] Ann. Surg., April, 1915.

In 11 cases of typhoid spine examined roentgenographically, reviewed by Halpenny,[15] the findings have varied from gross bony changes to none at all. Connor, Lovett, McCrae, Silver and Weigel report a total of 8 cases, with distinct changes of either the vertebræ, intervertebral disks or vertebral ligaments. Cutler and Petteshon in their cases found nothing abnormal. In 2 cases McCrae found deposits of new bone. In the first it filled the intervertebral space between the second and third lumbar vertebræ, apparently being deposited in the lateral ligaments and forming bony union; in the second the process extended from the second to the fifth lumbar vertebræ and appeared to involve both the lateral ligaments and part of the intervertebral disks. In the first of Myer's cases a synostosis between the second and third lumbar vertebræ, with loss of height from disappearance of the intervertebral space, was observed. In his second case there was clearly a synostosis of the eleventh and twelfth dorsal vertebræ, with diminution of height, owing to disappearance of this intervertebral space. In Silver's case the vertebral bodies seemed to be of normal thickness, but the space between them, corresponding to the disks, was absent, and the shadow of the first lumbar vertebra passed directly into that of the second; over this area there was increased density. On the right the lateral borders of the vertebral bodies formed an unbroken curved line; on the left there was an irregular shadow projecting outward between the transverse processes.

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[15] Loc. cit.

Elkin and Halpenny[16] review an additional 14 cases examined roentgenographically by various investigators, in 2 of which nothing was found. Of this series they cite Sireday's case, in which there was found thickening of the left side of the vertebral column of the second, third, and fourth lumbar vertebræ. In the other cases there were changes in the disks. Goddu found changes in the last dorsal and first lumbar vertebræ. Sweet found the disks gone between the fourth and fifth lumbar vertebræ and new-bone formation. McIntyre found the disk thickened between the fourth and fifth lumbar vertebræ and a deposit of new bone from the spine to the crest of the ilium; in his second case the fourth disk was thickened. Corling and Cain found a dense shadow on the sides of the ninth, tenth and eleventh dorsal vertebræ; a later roentgenogram of this was interpreted as an effusion beneath the periosteum and ligaments.

The cases reported by Wilcox and by Rugh and 3 of Carnett's cases showed the usual bony changes, while one of Carnett's cases showed nothing as late as the eleventh week.

In the case we report the roentgenograms show on the sides of the bodies of the second and third lumbar vertebræ a distinct clasp-like formation of new bone, producing a firm union and also a partial destruction of the disk and slight roughening of the body of the third lumbar vertebræ at the point of origin of the new bone. There is no evidence of involvement of any other vertebræ, though all were taken.

As demonstrated by the roentgen rays the early pathological findings consist in destructive changes in the bodies of the vertebræ, with absorption of the intervertebral disk; later there is proliferation of bone from the periosteum, with bony metamorphosis of the lateral ligaments. As first pointed out by McCrae, some cases may not reach the stage of new-bone formation, and roentgenograms may be negative early in the condition and positive later, as shown by Carnett's third case.

CASE REPORT. Mrs. W., white, aged twenty years, married; cotton-mill operative. She was admitted to the Presbyterian Hospital December 5, 1916, complaining of severe pain in the left flank and over the whole region of the left hip. Her family and past history were unimportant, except that she had had an attack of typhoid fever beginning in June, 1916, and lasting for nine weeks. She returned to work in the mill in September. About November 1 her present trouble started as a "catch" in her left hip on walking. This pain became rapidly worse, spreading to her back and hip and thigh, so that she has been confined to bed for the past month. The least movement, as turning in bed, brings on painful spasm of the back muscles. At present the back is better but the pain over the hip and crest of the ilium is worse. From pain and loss of

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[16] Loc. cit.

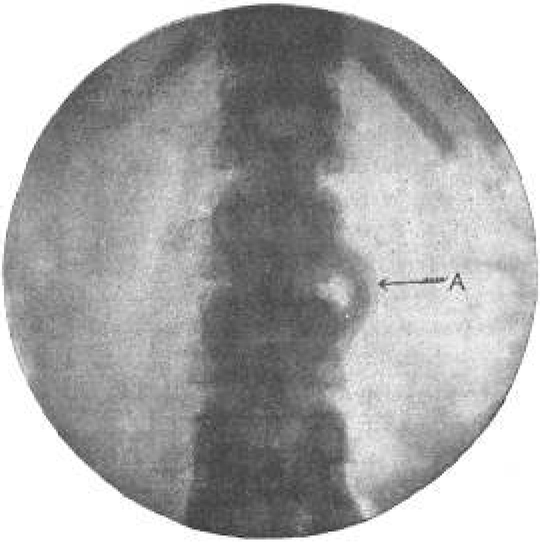

FIG. 1.—Clasp-like formation of new bone connecting second and third lumbar vertebræ.

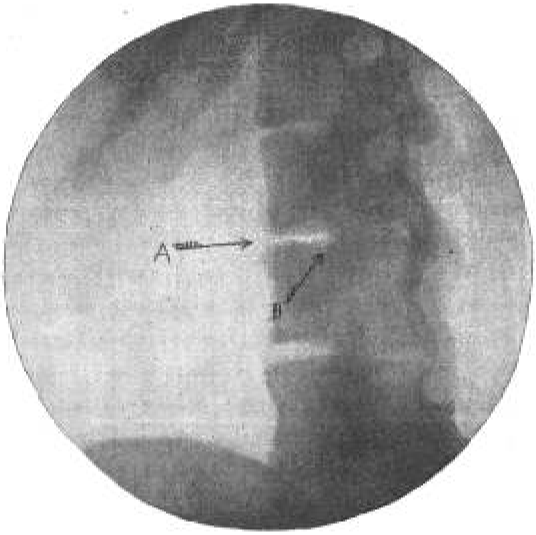

FIG. 2.—*A*, narrowing of vertebral slit from absorption of disk; *B*, area of *erosion* on body of third lumbar vertebra.

sleep she has lost appetite and flesh. Temperature from 99° to 100° on admission, with pulse 90 to 110. Her physician says that during the past month she has had high fever, reaching 103°, at times continuous, at other times intermittent.

Examination showed both upper and lower incisor teeth rotted off to the gums, with moderate inflammation of the gum margins. Eyes, throat, glands, heart, lungs, abdomen, skin and reflexes normal. No real or apparent shortening of the left leg. Trochanter below Nélaton's line. Motion of hip-joint normal. The motion of the lower half of the spinal column is very limited indeed. Moderate motion backward and to each side, all causing pain referred to left iliac crest. Cannot bend forward at all. Even when standing quietly the vertebral column is overextended and inclined to the left, with the left lumbar muscles spastic. Gait normal. Palpation over left lumbar back and ilium painful. Sacro-iliac joint not sensitive.

Flexion of extended legs on body equally limited on both sides because of the pain this produced in the back. Jarring the soles of both feet caused pain in the left lumbar region. Roentgenograms of all the teeth and the pelvic bones were normal. The changes in the second and third lumbar vertebræ are shown in the accompanying roentgenograms.

The back was strapped with adhesive and the usual immunizing doses of a commercial mixed typhoid vaccine were given. After the first dose, December 10, the temperature, which had been running from 99° to 100°, remained normal. After the second dose, December 14, she was allowed to return home, and was able to sleep through the night without pain. The third infection was given December 19, at which time the improvement was marked. Reported December 27, showing the back much improved; anxious to go to work.

January 17 the back was no longer painful and motion not much limited. Allowed to return to work. Roentgenograms showed no increase in bone formation.

February 16, she has worked without difficulty, except that her back tires more easily than formerly. No pain and no deformity. Very slight limitation of motion, with about 5 per cent. decrease in efficiency of the back. Roentgenograms showed no further changes.

Conclusions. It is difficult to estimate the value of the typhoid vaccine in this case, as the process was subsiding spontaneously. However, the temperature remained normal after the first dose, and there was a marked decrease in the pain the day after the second dose. From the clinical history of typhoid spine it seems probable that typhoid vaccine given early, would stop the development of this local infectious spondylitis.